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BULLETIN
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Lichens of the Black Hills and their Distribution.*

By Thomas A. Williams.

The thoughts presented in this paper are based upon a short study of the specimens in three collections from the Black Hills of South Dakota. The first of these was made by Dr. C. E. Bessey in the summer of 1891 at Custer City; the second by myself in August of the same year in the region surrounding Rapid City; and the third by P. A. Rydberg during the summer of 1892 mainly at and near Custer City.

One of the first points brought out by a study of the lichen flora of the Black Hills is that the number of rock lichens is, comparatively, very large, while tree-loving species are very scarce. Of the 83 species and varieties determined, 44, or more than 53 per cent., have so far been found on rocks only; 22, or nearly 27 per cent., grow on earth, while but 8, or less than 10 per cent., are found growing on trees exclusively. Six forms occur on both trees and rocks, one on both earth and rocks, one on both earth and rotten logs, and one parasitic on the thallus of various Cladoniæ.

Comparing this with a list of lichens found in Eastern Nebraska, the difference is at once seen to be quite striking. In this latter list, which consists of 115 species and varieties, 32, or nearly 28 per cent., grow on rocks; 68, or nearly 58 per cent., grow on trees; 13, or a little more than 9 per cent., are found growing on earth, and two species are parasitic. On the other hand, if we compare the Black Hills list with one by Henry Willey, based upon collections made in the Rocky Mountains by Dr. Coulter, found in the report of the latter in the United States Geological Survey of the Territories, we find a greater similarity, so far as distribution is concerned. In this case 34, or about 52 per cent., were collected on rocks; 18, or nearly 28 per cent., on earth; 12, or more than 18 per cent., on trees, and a single species on both trees and rocks. These numbers may be readily followed out in the appended table:

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* Read before the Section of Botany, A. A. A. S., Madison Meeting, August, 1893.

	NUMBERS.			PER CENTS.		
HABITAT.	Black Hills.	Eastern Nebr.	Rocky Mts.	Black Hills.	Eastern Nebr.	Rocky Mts.
On trees, ...	8	68	12	10	58	18
On rocks, ...	44	32	34	53	28	52
On trees and rocks, ...	6	. . .	1	. . .	. . .	. . .
On earth, ...	22	13	18	27	9	28
On earth and rocks, ...	1	. . .	. . .	. . .	. . .	. . .
On earth and wood, ...	1	. . .	. . .	. . .	. . .	. . .
Parasitic, ...	1	2	. . .	. . .	. . .	. . .
Totals, ...	83	115	65			

Twenty-five of the lichens found in the Black Hills are found also in Eastern Nebraska and 20 are found in the Rocky Mountains, while the Rocky Mountain list contains 16 species found in Eastern Nebraska. Nine forms are common to the three regions.

It would seem from this that the proportion of species common to the Black Hills and Eastern Nebraska and to the former locality and the Rocky Mountains is nearly the same when the numbers in all the lists are considered. From undetermined material on hand, however, it is very evident that when thoroughly worked up, the lichen flora of the Black Hills will show a great many more species found also in the Rocky Mountains.*

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* Most of the specimens examined have come from the eastern side of the Hills, and we may expect more Rocky Mountain forms from the western side, for reasons given later.

Of the 25 lichens common to Eastern Nebraska and the Black Hills, 10 are found on rocks, 5 on earth and 4 on trees. Of the 20 common to the Black Hills and Rocky Mountains, 11 grow on rocks, 5 on soil and but 3 on trees.

The 83 species and varieties found in the Black Hills belong to 22 genera, the three largest being *Lecanora* with 16 representatives, *Placodium* with 10, and *Cladonia* with 7, though *Lecidea,* in the Tuckermanian sense, when well worked over will probably give nearly or quite as many species as *Lecanora.* The lichens of the Rocky Mountain list are distributed among 17 genera, the three largest being *Lecanora* with 17 species and varieties, *Placodium* with 10 and *Lecidea* with 8.

Fourteen of the 17 genera are also found in the Black Hills and 13 in Eastern Nebraska, 12 of these being common to all three regions. The Nebraska list includes 31 genera.

Turning now to the distribution given by Tuckerman* to the species found in the Black Hills, and 45 are found to be general throughout the United States, 24 are Alpine or sub-Alpine, 6 are peculiar to the Pacific Coast, 3 to the Atlantic Coast, 3 to the great plains, and one a local form of a widely distributed species. One species, *Rinodina mamillana,* Tuckerm., has only been reported from the Sandwich Islands and the Galapagos Islands. Again, 43 of the species have been reported from Arctic America, while but 26 have been found in the Southern States, and 10 of the 26 are found only in the mountains, leaving but 16 that can really be said to belong to the South, and these are all included in those species whose distribution is said to be general throughout the United States. Sixty-two species are found in Europe, being either Alpine, sub-Alpine or confined to the North of of Europe. Seven species are peculiar to the United States.

A comparison of the Black Hills list with Tuckerman's Lichens of California, Oregon and the Rocky Mountains, shows that 24 of the species occur on the coast, while 30 are found in the Rocky Mountains, the 30 including nearly every one of the 24 reported from the coast. From this list and the one by Mr. Willey it may be seen that in all 34 species of the Black Hills list have been found in the Rocky Mountains.

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*Synopsis North American Lichens, Parts I. and II.

From the foregoing the following facts may be gleaned:

1. In the lichen flora of the Black Hills the rock lichens greatly predominate and have a more general distribution, the earth forms coming next.
2. This lichen flora is essentially northern in character.
3. It is more closely allied to the flora of the Rocky Mountains than to that of Eastern Nebraska and Dakota and hence, of course, to that of the Mississippi Valley.
4. That though intermediate between the lichen flora of the Rocky Mountains and that of the Mississippi Valley, it is not so distinctly so as the geographical position of the Black Hills region might lead us to expect.

The explanation of these conclusions can be found, undoubtedly, in the climate and geological make-up and history of the Black Hills region. The wide stretch of prairie, with its hot dry winds, lying between the Black Hills and the Lower Missouri Valley, as well as the Mississippi Valley proper, is not favorable to the development and growth of tree-loving species, even when plenty of trees are to be found. On the other hand, saxicoline and terricoline species survive because better protected and more likely to get enough moisture to retain life even in times of excessive drought. This condition of things would break the connection between the Black Hills and Mississippi Valley floras, and would tend to prohibit an interchange of forms except those few earth and rock forms able to exist.

East and south of the Black Hills lies the famous Bad Land region of South Dakota and Nebraska. This region is subject to hot, dry winds, mainly from the south or southeast, which strike the Black Hills on the east and south. As a result tree lichens are scarce in this part of the Hills, becoming more and more plentiful as we go farther into the heart of the region. The larger part of the tree lichens in the collections examined came from the cañons and gulches well up in the Hills. Rock lichens, particularly species of *Placodium*, *Lecanora* and *Rinodina*, are common all along the eastern edge of the Hills, as well as in the foot hills bordering them.

Geologically, the Black Hills are largely composed of various kinds of sandstone, limestone and granite, all of which furnish substrata very favorable to lichen growth. This is particularly true of the sandstones, which usually furnish the greatest variety of forms, as well as quantity of individual species. Furthermore, the Black Hills are very old, geologically speaking, and once covered a much greater area than at the present time, with probably closer connections with the Rocky Mountains. Alpine and northern forms common to these regions very likely came in with the same influx of species that sprinkled the mountain tops of both sides of our continent with closely allied forms.

List of Species and Varieties.

Ramalina pollinaria, Ach. Rocks. Custer City (Bessey.)

Usnea barbata (L.) Fr. var. ———? always infertile. Trees. Custer City (Rydberg, Bessey); Rapid City.

Alectoria jubata (L) Fr. var. *implexa*, Fr. Trees Custer City (Bessey).

Theloschistes polycarpus (Ehrh.) Tuckerm. Trees, Rapid City.

Parmelia olivacea (L.) Ach. Common on trees, Custer City (Rydberg); Rapid City.

Parmelia olivacea (L.) Ach. var. *panniformis*, Nyl. Rocks, Custer City (Bessey).

Parmelia caperata (L.) Ach. Common on trees and rocks. Mostly infertile, except on the latter substrate. Custer City (Rydberg); Rapid City.

Parmelia conspersa (Ehrh.) Ach. Common on stones. Custer City (Bessey); Rapid City.

Parmelia molliuscula, Ach. High, dry and sterile soil near Rapid City. Also common in the Bad Lands of Nebraska and the Dakotas.

Physcia pulverulenta (Schreb.) Nyl. Trees. Rapid City.

Physcia pulverulenta (Schreb.) Nyl. var. *muscigena* (Whlnb.) Schær. On earth among moss at bases of trees. Custer City (Bessey).

Physcia stellaris (L.) Tuckerm. Trees and rocks. Rapid City.

Umbilicaria rugifera, Nyl (?). Rocks. Rapid City.

Umbilicaria cylindrica (L.) Delis. Plentiful on rocks. Custer City (Rydberg); Rapid City.

Umbilicaria Muhlenbergii (Ach.) Tuckerm., var. *alpina*, Tuckerm. Rocks. Rapid City; Custer City (Bessey).

Umbilicaria vellea (L.) Nyl. Rocks. Rapid City.

Umbilicaria pustulata (L.) Hoffm. Rocks. Custer City (Bessey).

Sticta amplissima (Scop.) Mass. Trunks of trees and rocks. Custer City (Bessey); Rapid City.

Peltigera aphthosa (L.) Hoffm. Earth among moss. Custer City (Rydberg); Rapid City.

Peltigera horizontalis (L.) Hoffm. Earth, etc. Custer City (Bessey); Rapid City.

Peltigera rufescens (Neck.) Hoffm. Earth, etc. Custer City (Bessey); Rapid City.

Peltigera canina (L.) Hoffm. Earth, etc. Custer City (Bessey); Rapid City.

Peltigera canina (L.) Hoffm., var. *spongiosa*, Tuckerm. Earth among moss in deep cañons above Rapid City.

Peltigera canina (L.), Hoffm., var. *membranacea*, Ach. Earth, etc. Rapid City.

Solorina saccata (L.) Ach. Moist earth among moss on rocks in deep cañons. Plentiful. Rapid City.

Pannaria nigra (Huds.) Nyl. Common on rocks, particularly limestone. Rapid City.

Collema pulposum (Bernh.) Nyl. (?) Moist earth. Rapid City.

Leptogium lacerum (Sw.) Fr. Among moss. Rapid City.

Leptogium dactylinum, Tuckerm. Rocks. Custer City (Bessey); Rapid City.

Leptogium pulchellum (Ach.) Nyl. (?) Rocks and among moss. Rapid City.

Placodium elegans (Link) DC. Plentiful on rocks. Custer City (Rydberg, Bessey); Rapid City.

Placodium murorum (Hoffm.) DC., var. *miniatum*, Tuckerm. Rocks. Custer City (Bessey); Rapid City.

Placodium cirrochroum (Ach.) Hepp. This beautiful species occurs plentifully on rocks at Rapid City, but is always sterile.

Placodium fulgens (Sw.) DC. Sterile and calcareous soils. Rapid City. Not rare, but not nearly so plentiful as in the Bad Lands.

Placodium fulgens (Sw.) DC., var. *bracteatum*, Ach. With the species.

Placodium mycrophyllinum, Tuckerm. Dead wood and bark of trees, Custer City (Rydberg); Rapid City. A common species.

Placodium citrinum (Hoffm.) Leight. Very plentiful on rocks. Custer City (Bessey); Rapid City.

Placodium ferrugineum (Huds.) Hepp., var. *Bolanderi*, Tuckerm. Rocks. Custer City (Bessey), rare.

Placodium vitellinum (Ehrh.) Næg. and Hepp. Rocks. Custer City (Bessey); Rapid City. Not uncommon.

Lecanora rubina (Vill.) Ach. Rocks. Custer City (Bessey, Rydberg); Rapid City. Very common.

Lecanora rubina (Vill.) Ach., var. *opaca*, Ach. With the species.

Lecanora muralis (Schreb.) Schær. Rocks. Rapid City.

Lecanora muralis (Schreb.) Schær., var. *saxicola*, Schær. Rocks. Rapid City. Not uncommon.

Lecanora frustulata (Dicks.) Mass. Rocks. Custer City (Bessey), and what is probably this species at Rapid City.

Lecanora sordida (Pers.) Th. Fr. Rocks. Rapid City.

Lecanora subfusca (L.) Ach. Trees, wood and stone. Rapid City.

Lecanora Haydeni, Ach. Rocks and dead wood. Rapid City. Not uncommon and very variable.

Lecanora melanaspis (Wahl.) Ach. Rocks. Rapid City, and what seems to be the same thing at Custer City (Bessey). Rare.

Lecanora cinerea (L.) Sommerf. Rocks. Custer City (Bessey); Rapid City. Common.

Lecanora calcarea (L.) Sommerf. Rocks. Rapid City.

Lecanora chlorophana (Wahl.) Ach. Rocks. Rapid City.

Lecanora xanthophana, Nyl. Rocks. Rapid City. Common.

Lecanora xanthophana, Nyl., var. *dealbata*, Tuckerm. Rocks. Rapid City. Often occurs with the species.

Lecanora glaucocarpa (Wahl.) Ach. Rocks. Rapid City. Common.

Lecanora fuscata (Schrad.) Th. Fr. Rocks. Custer City (Bessey); Rapid City Very common.

Rinodina oreina (Ach.) Mass. Rocks. Custer City (Bessey); Rapid City. A very common species.

Rinodina mamillana, Tuckerm. Rocks. Custer City (Bessey). A single specimen, evidently this Sandwich Island species.

Urceolaria scruposa (L.) Nyl. Earth and rocks. Rapid City. Exceedingly common.

Urceolaria scruposa (L.) Nyl. var. *gypsacea*, Nyl. Calcareous earth near Rapid City. It occurs in great abundance in the Bad Lands.

Urceolaria scruposa, var. *parasitica*, Sommerf. On thallus of various species of *Cladonia*. Rapid City, and also common in the Bad Lands.

Cladonia alcicornis (Lightf.) Flœrk. Sandy soils. Rapid City. Not uncommon.

Cladonia cariosa (Ach.) Spreng. Earth. Custer City (Rydberg); Rapid City. Abundant.

Cladonia pyxidata (L.) Fr. Earth, etc. Custer City (Bessey, Rydberg); Rapid City.

Cladonia pyxidata (L). Fr. var. *pocillum*, Ach. Earth. Rapid City. Not uncommon.

Cladonia fimbriata (L.) Fr. var. *tubæformis*, Fr. Earth and rotten logs. Rapid City. Common.

Cladonia gracilis (L.) Nyl. var. *verticillata*, Fr. Earth. Custer City (Rydberg); Rapid City. Not uncommon.

Cladonia macilenta (Ehrh.) Hoffm. Dead wood, etc. Rapid City.

Biatora Russellii, Tuckerman. Rocks and earth. Rapid City. Very plentiful.

Biatora decipiens (Ehrh.) Fr. Calcareous earth. Rapid City.

Biatora coarctata (Sw.) Tuckerm. Rocks. Custer City (Bessey); Rapid City.

Biatora hypnophila (Turn.) Tuckerm. Moss, etc. Rapid City.

Lecidea cœruleo-nigricans (Lightf.) Schær. Earth. Rapid City. Common.

Lecidea tessellata, Flœrk. Rocks. Custer City (Bessey); Rapid City. Common.

Lecidea polycarpa, Fr. Rocks. Rapid City.

Lecidea lapicida, Fr. Rocks. Rapid City (Bessey); Rapid City.

Lecidea enteroleuca, Fr. Trees and rocks. Custer City (Bessey); Rapid City, exceedingly common and variable.

Lecidea Morio, Schær. Rocks. Custer City (Bessey); Rapid City.

Buellia albo-atra (Hoffm.) Th. Fr., var. *saxicola*, Fr. What seems to be this variety on rocks. Rapid City. Rare.

Buellia parasema (Ach.) Th. Fr. Trees. Rapid City.

Buellia coracina (Hoffm.) Th. Fr. Rocks. Custer City (Bessey); Rapid City.

Buellia petræa (Flot.) Tuckerm., var. *Montagnæi* (Flot.) Tuckerm. Rocks. Custer City (Bessey); Rapid City. Common.

Buellia geographica (L.) Tuckerm. Rocks. Custer City (Bessey); Rapid City.

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